Feature Section

The Ideal Phosphor[1]

Roland Ward

Within the past year, four books have been added to the literature on luminescence by recognized authorities in the field[2].

The theory of ideal and real crystals has been thoroughly discussed and its application to the phenomenon of luminescence of solids is amply demonstrated in all of these volumes. The phosphorescent solid appears to present the greatest opportunity for speculation. The problem discussed here is limited to this type of crystals which may be characterized as having all of the following properties:

1. Luminescence continues after exposure to the exciting radiation has ceased.
2. The rate of decay of luminescence is slowed by lowering the temperature.
3. The excited phosphor is an electronic conductor after exposure to the exciting radiation has ceased.
4. The nature of the emission band is not markedly altered with temperature change.

The theoretical model which has been advanced to explain these properties consists essentially of a periodic lattice representing the host crystal in which activator ions are distributed in a random fashion. The activator ion is capable of using energy absorbed directly or from the lattice to promote one of its electrons to a sufficiently high energy state so that it will enter the conduction band of the crystal. Some of these excited electrons are caught in potential wells or traps where they may be held for some time. The release of electrons from the traps is normally effected by the thermal energy of the lattice. The trapped electrons are promoted to the conduction band whence some of them may return to the ground state of the activator ion with the emission of light.

The model serves to explain, at least qualitatively for this type of phosphor, such phenomena as the shift in the emission band when the same activator is used with different host crystals, and the fact that a broad emission band is obtained instead of narrow bands or lines.

The only unsatisfactory part of the picture is the unspecified origin of the electron traps. It has been suggested that the traps are due to lattice imperfections of one kind or another (local strains, defect lattices, mosaic structure) or that they are introduced with the activator ion itself and constitute an integral part of the active center. It may also be that they are introduced by the excitation process and disappear when the phosphor returns to the ground state. Perhaps all of these are factors in the production of electron traps and it may even be that the traps would be present in an ideally perfect crystal.

It is in the hope for some experimental approach to this problem that the concept of a sort of practical "ideal phosphor" is advanced. In the arrival at the properties of an ideal gas, the gases which were studied were not too far removed from ideal behavior. The theoretical model for phosphors, on the other hand, has been derived from the study of quite complicated systems. Is it possible to select a simple phosphor system which would be a close approximation to the ideal?

The first restriction we might impose would be to select a phosphor which in the ground state would be an ideal solid solution. An ideal solid solution would be an ideally imperfect crystal (one which is at equilibrium with respect to Schottky and Frenkel defects) throughout which are distributed at random ions different from those of the host crystal. These foreign ions would be the cationic activator of the phosphor and are assumed to be in low concentration. The interaction of the activator ion with its contiguous ions should be as nearly the same as that of the host crystal cation as possible. This means that the solution should be substitutional and the impurity cation should be about the same size and have the same charge as the host crystal cation.

The selection of a host crystal which would be most likely to give rise to a phosphor of this type could be made by the following criteria:

1. The anion of the host crystal.—It appears to be a fairly general rule that oxide and fluoride crystals are not the type which give rise to phosphors with a persistent afterglow. Many of those which have an afterglow have the temperature-independent luminescence with an exponential decay rate.

This would eliminate the alkali fluorides and the oxides of divalent and trivalent cations as base materials. Unless some exceptions (perhaps the alkaline earth oxides) are known, a serious restriction is imposed here on the choice of host crystals. The choice appears to be limited to chlorides, bromides, iodides, sulfides, selenides, and possibly nitrides, carbides, and phosphides.

2. The cation of the host crystal.—It would be necessary to avoid the kind of subtance, such as zinc sulfide, in which the cation may adopt a lower oxidation state and thus become

[1] Keynote address delivered by Professor Ward, of the University of Connecticut, before the Symposium on Luminescence held at the Cleveland Meeting of the Society, April 20, 1950.

[2] All of the phosphor systems mentioned in this paper are discussed in detail with appropriate references in these books:

H. W. Leverenz, "An Introduction to Luminescence of Solids," John Wiley & Sons, Inc., New York (1950).

Peter Pringsheim, "Fluorescence and Phosphorescence," Interscience Publishers, Inc., New York (1949).

F. A. Kroeger, "Some Aspects of the Luminescence of Solids," Elsevier Publishing Co., Inc., New York (1948).

G. F. J. Garlick, "Luminescent Materials," Clarendon Press, Oxford (1949).

a potential activator. The introduction of another activator may obscure or even eliminate the emission due to the reduced cation of the host crystal but the lattice distortion which might be introduced by the reduced cation would still be present.

The selection would be made among substances with relatively stable cations such as the alkali or alkaline earth ions or possibly Be^{+2}, Mg^{+2}, Al^{+3}, Sc^{+3}, Y^{+3}, or La^{+3}.

3. A place for the activator ion.—One would like to be reasonably sure that impurity ions, which are to be introduced in the crystal, will adopt a single type of position. If substitutional positions are occupied by some activator ions and interstitial positions by others, it is reasonable to suppose that we would have two sets of active centers which would behave somewhat differently. A choice should be made, then, among crystal types which do not lead us into this dilemma. In the sphalerite and wurtzite structures, there are vacant tetrahedral sites which some entering cations are supposed to occupy in giving interstitial solid solutions, but there are also much more roomy octahedral sites available. The tendency of the activator ion to form either tetrahedral or octahedral covalent bonds may be of more importance than the relative sizes of available sites. It would seem to be advisable, however, to avoid the uncertainty which this type of lattice inevitably introduces.

The same problem presents itself with the spinel type of structure. The rock salt type of structure, on the other hand, has the cations in octahedral holes while the smaller tetrahedral cavities are vacant. Such a structure appears to offer a better inducement for the foreign cations to enter substitutional positions. Perhaps it should be noted that the size of the anion relative to the cation would be an important factor in this kind of crystal. In a close-packed anionic structure, the tetrahedral hole can accommodate without distortion a cation with radius 0.41 times that of the anion, and an octahedral hole a cation of radius 0.59 times that of the anion. When the cation has a larger radius than 0.59 times the anion radius, the tetrahedral holes become larger due to the general distensions of the structure but there would always be a greater tendency for a large cation to enter the octahedral positions.

If these considerations are valid, the selection of an ideal host crystal is limited to the alkali metal halides, the sulfides or selenides of magnesium and the alkaline earths, and possibly the nitrides or phosphides of scandium, yttrium, and lanthanum if the latter are not too deeply colored.

The selection of activator ions for the ideal phosphor should be made on the basis of ionic radius and ionic charge. The size of the impurity cation should be as close as possible to that of the cation of the base material. This factor may not be too critical, however, and a difference of up to 20 per cent might not be too much. The charge of the activator ion should be the same as that of the host crystal.

TABLE I. *Potential activator ions*

Valence 1		Valence 2		Valence 3	
		Ge (0.65)		As (0.69)	
		Pt (0.52)		Ti (0.70)	
Cu (0.58, 0.96)		Ti (0.76)		V (0.75)	Al (0.55)
Zn (0.88)?	Na 1.00	V (0.82)	Mg (0.65, 0.75)	Cr (0.70)	
Cd (1.1)?		Cr (0.85)		Mn (0.69)	
In (1.0)?		Mn (0.83)		Fe (0.67)	
Ag (0.97, 1.26)		Fe (0.80)		Co (0.65)	
	K				
Au (1.37)	1.33	Co (0.78)		Rh (0.75)	
					Sc
Tl (1.50)		Ni (0.74)		Sb (0.90)	(0.83)
			Ca		
		Cu (1.01)?	1.05		
		Sn (1.02)	Sr 1.18	Eu (1.05)	La (1.22)
		Ag ?		Ce (1.10)	
			Ba		
		Eu (1.1)	1.38	Bi (1.20)	
		Pb (1.2)			

Table I gives some of the possible activator ions with their ionic radii, and indicates the most suitable base material cation with which they should be used.

Among the proposed univalent activators Zn^+ and Cd^+ are given. If these can be formed in the zinc sulfide and cadmium sulfide crystals, their existence should be possible in the alkali halides.

The study of phosphors consisting of alkali halides activated with Ag^+ and with copper (presumably Cu^+) has revealed a complex mechanism when the excitation is induced with short wavelength ultraviolet. The emission is in the ultraviolet, has a first order decay rate, is temperature dependent, and is photostimulated by blue light. The interpretation offered is that the anion is really the activator, the impurity cation serving as an electron trap.

Tl^+ has been investigated very thoroughly as an activator in KCl and, while it produces luminescence of long duration, it does so only at fairly high concentrations and with ultraviolet excitation of wavelength less than 2000 Å. Activator

ion-pair formation and complex ion formation have been postulated to explain the behavior of this phosphor. Neither In^+ nor Au^+ appear to have been used as activators in the alkali halide crystals.

Some of the activator ions such as Ti^{+2}, V^{+2}, and Cr^{+2}, proposed for divalent systems, may be difficult to obtain experimentally. The radii of some of these ions do not appear to be known with any degree of accuracy. Some of the values, based on interatomic distances in crystals, are quite different from the calculated values and indicate that the bonding is by no means ionic. Indeed, with the possible exception of Eu^{+2} one might expect that most of these ions would tend toward some sort of covalent bonding in octahedral association with all anions other than F^- and possible O^{-2}.

TABLE II. *Composition of Lenard phosphors**

CaS	Cu	Pb	Mn	Fe	Eu	Sn
SrS	+	+	+	+	+	+
BaS	+	+	0	−	−	−
CaO	+	+	+	−	+	−
SrO	+	+	+	−	−	−
BaO	+	+	0	−	−	−
CaSe	+	−	0	+	−	−
SrSe	+	−	+	−	+	−
BaSe	+	+	−	−	−	−
MgS	?	?	+	−	−	−

0 = Negative results, + = Positive results, − = Apparently not tested.

* Pringsheim, "Fluorescence and Phosphorescence," p. 596.

A list of likely phosphors of this type is given in Table II.

The investigation of these phosphors (listed in Table II), for which positive results have been obtained, has not been as thorough as that of the alkali halide phosphors. There may be some doubt as to the valence of the copper ion in the alkaline earth sulfide phosphors since the emission color is changed sharply in the presence of halide ions in the flux and other conditions of preparation which suggest that the effective activator may be the cuprous ion.

Consideration of the possible ideal phosphors in the alkali halide systems shows that the photoconductive properties may be due to the alkali halide. The short wavelength of radiation necessary to produce photoconductivity and the similarity of the emission spectra of the photoconductive and non-photoconductive phosphors point to this interpretation.

The alkaline earth sulfides and selenides may possibly give rise to phosphors which do not have this complicating factor. These phosphors, however, are not very attractive to the physicists since they are at present available only as finely divided crystalline powders or as sintered masses containing excess flux.

The most promising of all the possibilities appears to be the europium-activated strontium sulfide. There is ample evidence that the europium is in the divalent state, and the size of the europous ion is almost identical with that of the strontium ion. The phosphor is photoconducting and is excited by visible light.

With the new high temperature furnaces now available and the recent skills shown in growing single crystals, it should be possible to prepare single crystals of this phosphor large enough for a thorough examination of its properties. It would be especially interesting if a range of crystal sizes from the order of 100 Å up to visible crystals could be prepared. A study of their properties might give some information about the importance of crystal defects due to mosaic structure. A thorough and systematic study of the effects of host crystal cations and anions could be made by investigation of the europium-activated mixed bases: (Ca,Sr) S;(Ba,Sr) S; Sr(S,Se); (Ca,Sr)(Se,S); and (Ba,Sr)(Se,S). The effect of introducing additional Schottky defects could be studied with europium-activated mixed bases of the type (Sr,La)S and Sr(S,P). These might be compared with the phosphor $SrS:Ce^{+3}$ in which the activator ion itself introduces Schottky defects. The effect of annealing these phosphors at different temperatures down to about 300°C should also be considered.

It would be interesting to see if there is any correlation among the glow curves and the decay rates and photoconduction at various temperatures of a series of phosphors in which the lattice defects increased.

Perhaps an approach of this kind would yield some definite knowledge of the nature and source of electron traps in these phosphors.

MANUSCRIPTS FOR FALL MEETING

Manuscripts are now being received for the Fall Meeting of the Society, to be held at the Statler Hotel in Detroit, Michigan, October 9, 10, 11, and 12, 1951. Subjects to be covered at the technical sessions will be Corrosion, Electrodeposition, and Organic Electrochemistry. To be considered for this meeting, triplicate copies of manuscripts or abstracts (not to exceed 75 words in length) must be received at Society headquarters, 235 West 102nd Street, New York 25, N. Y., not later than August 1, 1951.

Highlights of a Successful Meeting

An outstanidng technical program, consisting of over 120 papers and an Industrial Electrolytic round table, attracted 596 members and guests to the 99th meeting of the Society, held in Washington, D. C., April 8th through 12th.

Supplementing the technical sessions were: a Monday luncheon with Dr. E. U. Condon as speaker, followed by the annual business meeting of the Society; the Richards Memorial Lecture Monday afternoon; a buffet supper and entertainment Monday evening; a reception honoring President and Mrs. Faust Tuesday evening, followed by the annual banquet which featured the presidential address and the award of the Young Author's and Turner Book Prizes; Electrothermic, Electronic, Industrial Electrolytic, and Rare Metals group luncheons; tours of the National Bureau of Standards; and an extensive Ladies' Program.

Credit for the success of this meeting belongs to the Division officers who arranged the technical program, and to the Washington Committee who, with the National Officers, made all of the local arrangements.

Top row, left to right, J. O'M. Bockris, Richards Memorial Lecturer and Faraday Society delegate; Paul L. Howard, Convention Chairman, with President Charles L. Faust as he presents scroll to Dr. E. U. Condon in recognition of the National Bureau of Standards' 50th anniversary; Rare Metals are discussed by John W. Marden, J. R. Musgrave, Donald M. Wroughton, Bruce W. Gonser, and Alan U. Seybolt.
Center row, Partial view of luncheon for Rare Metals group; newly elected Vice-President Marvin J. Udy and President Ralph M. Hunter; Young Author's Prize Winner, George W. Murphy.
Bottom row, E. G. Widell, Roland Ward, and J. W. Marden hear H. C. Froelich congratulate E. F. Lowry on fine Electronics sessions, with J. R. Musgrave, Donald Wroughton, and H. R. Schoenfeldt approving; President Faust and Secretary Linford at annual banquet; also Dr. and Mrs. Hunter in receiving line with Dr. Condon who is being congratulated by Mrs. William Blum.

Activities of the Board of Directors

The following are condensed minutes of the meeting of the Board of Directors, held at 2:00 P.M., April 8, 1951, Wardman Park Hotel, Washington, D. C., President Faust presiding.

Report of the President

The President announced that the new "Aims and Activities" booklet has been published and is now available for use among the members in soliciting new applications for membership.

Future Meetings

The plans for the Detroit Meeting, to be held October 9–12, 1951, were discussed, and from the plans already made by the Detroit Section it is apparent that the meeting will be a very successful affair.

Considerable discussion was devoted to the Philadelphia Meeting, to be held in the spring of 1952. This is our 50th Anniversary Meeting, and a great deal of emphasis will be placed on the history of the Society. Details of recommendations to the Philadelphia Section, were referred to the Ways and Means Committee for study.

Treasurer's Report

The Treasurer reported that the Central Hanover Bank has complete control over the Weston Funds, and that in the course of the last fifteen years the principal on this fund has decreased considerably due to poor investments. On the basis of the fact that the Weston Fund has depreciated, it was considered advisable to withhold the appointment of a Weston Fellow for the year 1951–1952.

Communications from the Secretary

The Secretary requested and received authorization for the purchase of new addressograph and graphotype machines. These pieces of equipment are necessary to replace old, worn-out models in use at the National Office. The addressograph machine will make it possible to give added service to the Divisions and Sections, since the machine is selective and, therefore, mail circularization of the Divisions and Sections will be relatively simple. Also, the Secretary recommended that, with the purchase of the new machine, the home office should address the wrappers for the JOURNAL, thereby avoiding duplication of addressograph files now used by the printer. This will result in sufficient saving to more than pay for the new equipment in ten years.

Ways and Means Committee

The Ways and Means Committee suggested that all Divisions and Sections present a financial statement covering the previous fiscal year prior to any application for financial assistance, and recommended changes in By-Laws to correspond with this request.

Publication Committee

Dr. Uhlig, reporting for the Publication Committee, stated that we are now receiving 25 per cent more technical papers than a year ago. However, the percentage of papers rejected is also increasing. The JOURNAL is now publishing more technical material and less nontechnical material, resulting in our maintaining expenditures within the budget, even though more technical papers are being presented to the members.

The Board of Directors expressed its appreciation to Dr. Uhlig for the work that he has done in building the JOURNAL up to its present high plane. This expression of appreciation was given since Dr. Uhlig's resignation as Editor became effective at the Washington meeting.

Mr. F. L. LaQue, Business Manager of the JOURNAL, reported that new arrangements have been made for securing advertising, whereby Richard Rimbach Associates will act as agent. By this means, the Society will save considerable sums of money as long as the advertising income remains at a moderate level, since the charges by the agency are on a percentage of income basis.

Dr. R. M. Burns, newly-appointed Chairman of the Publication Committee, then proposed the following organization: R. M. Burns, Chairman; F. L. LaQue, Business Manager; Norman Hackerman, Technical Editor; U. B. Thomas, News Editor; Eleanor Reid, Managing Editor; Mary F. Murray, Assistant Editor; and Professor Cecil King, Associate Editor, this group to work with the various Divisional and Regional Editors.

Dr. Burns also reported progress on the selection of a publisher for a monograph series already under consideration.

Local Section Advisory Committee

Dr. Moore reported a very active meeting of that Committee, showing a definite increase in interest of the local Sections in the operation of the National Organization.

Palladium Medal Committee

Dr. Uhlig reported that the design for the Palladium Medal has been proposed, and the die is now in the process of being prepared. The first Palladium Medal will be presented at the Detroit Meeting.

Committee Appointments

At the conclusion of the regular business, President Faust turned the meeting over to President-Elect R. M. Hunter. Dr. Hunter announced the following committee appointments for 1951–1952:

Ways and Means: C. L. Faust, Chairman, W. C. Moore, J. C. Warner, Sherlock Swann, Jr., J. N. Mrgudich, R. A. Schaefer, R. J. McKay

Finance: R. J. McKay, Chairman, H. B. Linford, C. L. Faust, E. G. Widell, F. L. LaQue

Publicity: H. R. Neumark, Chairman, R. A. Woofter

Sustaining Membership: W. L. Prine, Chairman, J. R. Musgrave, Vice-Chairman, J. C. Schumacher, Roy E. Heath, W. G. Harvey, Francis M. Turner, and C. A. Crowley

Local Section Advisory: F. A. Lowenheim, Chairman (other members to be appointed by the Sections)

Adjournment

The meeting was adjourned at 5:50 P.M.

HENRY B. LINFORD, *Secretary*

Hunter to Propose Nominating Committee

President Ralph M. Hunter announces that he plans to recommend to the Board of Directors at its coming meeting, June 30, 1951, that the following constitute a committee to nominate Society officers for the year 1952–53: Dr. Neil J. Johnson, Chairman, National Carbon Division, Union Carbide and Carbon Corporation, Niagara Falls, New York; Past President A. T. Hinckley, Oldbury Electrochemical Company; Dr. William C. Gardiner, Mathieson Chemical Corporation; Mr. M. S. Kircher, Hooker Electrochemical Com-

pany; Mr. Eugene C. Nutting, The Carborundum Company.

Please note: The Nominating Committee welcomes suggestions from the members as to candidates for the various offices. These recommendations should be sent to the Chairman at the address given above.

Divisions Elect Officers in Washington

Electronics Division

The Electronics Division held its annual business meeting on April 11th during the spring meeting of the Society in Washington, D. C. The following reports were presented by the group chairmen:

The Rare Metals Group presented a one day symposium at the Washington Meeting and held a half-day joint session with the Electrothermics Division. There was considerable interest in the papers and the entire symposium, under the chairmanship of Dr. Bruce Gonser, was well received.

The Luminescence Group under the chairmanship of Dr. H. C. Froelich presented a two-day symposium which maintained the high quality of previous luminescence symposia, in which interest is increasing yearly.

Plans for the Philadelphia Meeting in the spring of 1952 were formulated. It is expected that four symposia will be presented. Chairmen for these are:

Luminescence—Dr. Roland Ward
Rare Metals—Dr. Donald Wroughton
Methods of Applying Phosphors—Dr. C. W. Jerome
Instrumentation—Mr. R. H. Cherry

All chairmen are planning to begin work immediately on these symposia. Any members who have papers or know of possible papers are requested to advise the appropriate chairman.

A discussion was held regarding the publication of the many symposia papers. A committee headed by Mr. Widell was appointed to consider ways and means of publishing pertinent facts of each paper either before or during the meeting.

In line with the action of the Board of Directors' request for an article on the progress of the sciences covered by each Division since the inception of the Society in 1902, Dr. John W. Marden was appointed chairman of a committee to write such a paper for publication in the JOURNAL. Dr. Marden was instructed to call upon any members of the Division who could furnish assistance and information in this task.

The report of the Nominating Committee headed by Dr. Marden was presented. There being no additional nominations from the floor, the Secretary was instructed to cast a ballot for the slate prepared by the Nominating Committee as follows:

General Chairman—H. C. Froelich, General Electric Company, Cleveland, Ohio
Vice-Chairman for Rare Metals Group—D. M. Wroughton, Westinghouse Electric Company, Pittsburgh, Pennsylvania
Vice-Chairman for Luminescence Group—Roland Ward, University of Connecticut, Storrs, Connecticut
Vice-Chairman for General Electronics Group—C. W. Jerome, Sylvania Electric Products Incorporated, Salem, Massachusetts

The three-year term of the *Secretary-Treasurer*, J. R. Musgrave, The Eagle-Picher Company, Joplin, Missouri, has one more year to run.

Dr. Lowry expressed his appreciation to the officers and members of the Division for their cooperation and enthusiasm during the past year. The new officers were then installed.

Dr. Froelich, the new Chairman, appointed Dr. Lowry as Chairman of the Nominating Committee. An informal discussion followed regarding the activities, problems, and plans of the coming year.

J. R. MUSGRAVE, *Secretary-Treasurer*

Electrothermic Division

The annual business meeting of the Electrothermic Division of The Electrochemical Society was held in the Continental Room of the Wardman Park Hotel, Washington, D. C. on April 12, 1951, at 12:30 P.M., with Dr. Julian W. Glasser presiding.

Thirty-five members and one guest, Miss Eleanor Reid, Managing Editor of the JOURNAL, were present.

Following the annual report of the Secretary-Treasurer, nominations of officers for 1951–1953 were presented by A. T. Hinckley, Chairman of the Nominating Committee. These nominees, who were unanimously elected, were:

Chairman—C. H. Chappell, National Carbon Company, Niagara Falls, New York
Vice-Chairman—A. E. Pavlish, Kelley Island Lime & Transport Company, Cleveland, Ohio
Secretary-Treasurer—I. E. Campbell, Battelle Memorial Institute, Columbus, Ohio
Members-at-Large—Guy H. Fetterley, Norton Company, Chippawa, Ontario, and A. P. Thompson, The Eagle-Picher Company, Joplin, Missouri

Dr. Glasser announced plans for the Division's role in the 50th Anniversary Meeting of the Society in Philadelphia, and for the contributions to special anniversary issues of the JOURNAL. A report of progress on the Division's Monograph on "High-Temperature Materials" was presented by the Secretary, and the meeting was concluded with brief remarks by C. H. Chappell, the new Chairman.

I. E. CAMPBELL, *Secretary-Treasurer*

Industrial Electrolytic Division

At a luncheon meeting of the Industrial Electrolytic Division held in Washington on April 12th, the following officers were elected for the current year:

Chairman—Frank Woodman, Southern Alkali Corporation
Vice-Chairman—Dean Hubbard, Hooker Electrochemical Company,
Secretary-Treasurer—Kenneth B. McCain, Wilbur B. Driver Company

KENNETH B. MCCAIN, *Secretary-Treasurer*

Theoretical Division

The Theoretical Division held its annual business meeting and election of officers on Tuesday, April 10th, during the meeting in Washington.

The meeting was called to order at 1:30 P.M. by the Chairman, who expressed his appreciation to those who had taken part in the symposium on electrode kinetics. The symposium met with favorable response by a large audience, some of whom were forced to stand at the rear of the room after the 150 to 200 chairs were all occupied. This represented the largest attendance at a symposium sponsored by the Theoretical Division in some years.

Discussion of topics for next year's symposium indicated that polarization might meet general approval. A question was raised regarding the lack of papers on electrolytes published by The Electrochemical Society. It was thought by some that even though papers on this subject are now published elsewhere, the Society should arrange a symposium on electrolytes in order to encourage presentation of more papers of this kind within the Society.

The chairman of the nominating committee, Dr. Thomas May, reported the following slate of officers:

Chairman—Walter J. Hamer, Bureau of Standards

Vice-Chairman—Paul Fugassi, Carnegie Institute of Technology

Secretary-Treasurer—A. J. de Bethune, Boston College

Since there were no further nominations from the floor, a motion was made to close nominations, which was seconded and voted. The Chair thereupon instructed the secretary to cast one ballot in favor of the nominees.

The next meeting of the Division will be at Philadelphia in the spring of 1952.

H. H. Uhlig, *Chairman*

Short Corrosion Course at M.I.T.

M.I.T. announces that the following authorities in Corrosion will lecture at the one-week intensive course on corrosion to be held in Cambridge from June 18 to 23, 1951:

1. "Fundamentals of Corrosion Reactions and Control," H. H. Uhlig, Associate Professor of Metallurgy, M.I.T., and Carl Wagner, Visiting Professor of Metallurgy.

2. "Metals and Alloys: Properties, and a Guide to Their Proper Selection," W. Z. Friend, International Nickel Company, Inc.

3. "Cathodic Protection: Theory and Measurements," J. M. Pearson, Sun Oil Company; "Practice and Economics," L. P. Sudrabin, Electro Rust-Proofing Corporation.

4 "Metallic and Organic Coatings: Selection, Application, and Behavior," R. M. Burns, Bell Telephone Laboratories.

5. "Treatment of Environment," Norman Hackerman, Department of Chemistry, University of Texas.

6. "Design of Equipment from a Corrosion Standpoint," R. B. Mears, United States Steel Company.

7. "Principles and Practice of Corrosion Testing," F. L. LaQue, International Nickel Company, Inc.

In addition, for those interested in marine fouling, a trip will be arranged on Saturday, June 23rd, to the William F. Clapp Laboratories, located on the shore at Duxbury, Massachusetts.

The course is designed to meet the needs of the research director and plant engineer who wish to review recent trends and developments, and will also serve technical laboratory and engineering personnel who want to know more about corrosion and how to solve current problems. A knowledge of first-year college chemistry is essential to an understanding of the course material. Tuition is $50.00.

Applications should be addressed to Professor Walter H. Gale, Director of the Summer Session, Room 3-107, Massachusetts Institute of Technology, Cambridge 39, Massachusetts.

Third Meeting of International Committee

The third meeting of the International Committee of Electrochemical Thermodynamics and Kinetics (C. I. T. C. E.) will take place at the University of Bern, Switzerland, during the week of August 6th. Information concerning the arrangements and on all other activities of the Committee can be obtained from Dr. Marcel Pourbaix, Secretary-Treasurer of C. I. T. C. E., Laboratory of Applied Physical Chemistry, University of Brussels, 50 avenue F. D. Roosevelt, Brussels, Belgium.

A report of the second meeting of the International Committee was published in the March 1951 Journal, page 43C under Letters to the Editor.

Increased Output at Western Electrochemical

The Western Electrochemical Company, with offices at 9036 Culver Blvd., Culver City, California, has announced a several-fold expansion of its capacity for producing battery-grade manganese dioxide. The process and equipment have been developed by Western Electrochemical Company and involve the use of domestic ores which are obtained in the vicinity of the operating plant at Henderson, Nevada. An exceptionally high quality product is obtained. Mr. Joseph G. Schumacher, Vice-President and Research and Development Director, is responsible for the working out of the process. PSB

Electroplaters Organize in Texas

Local sections of the American Electroplaters' Society were organized during the month of March in both Dallas and Houston, Texas. Mr. Arthur Lagozzo, of New Haven, Connecticut, past national president of the Society, personally presented the local sections with their charters. The Houston Section held its charter meeting on March 30th. Approximately 50 men attended to receive the charter and hear Mr. Lagozzo deliver a talk on chrome and nickel plating. OO

News from India

Mr. G. D. Birla, one of the leading industrial magnates, has donated a sum of Rs. 21 lakhs ($420,000) to the Council of Scientific and Industrial Research, India, for the establishment of an electronic and radio engineering research institute.

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Research work on electrodeposition has been organized at the Indian Institute of Science, Bangalore. Preliminary investigations are being carried out on the production of aluminum from the electrolysis of fused aluminum chloride.

* * *

The Government of the State of Mysore is going ahead with its industrial development program. Installation of electric pig iron furnaces with a productive capacity of 100 to 110 tons per day is in progress at the Mysore Iron and Steel Works. A new ferro-silicon plant with a capacity of 7000 tons per year has been completed and is now in operation. The Government Porcelain Factory is also being expanded to enable it to cope with the heavy demand for electro-porcelain. TLRC

Du Pont Dedicates New Research Addition

The Du Pont Company's new Experimental Station addition at Wilmington, Delaware, a $30,000,000 investment, was dedicated on May 10th before an assembly of some 200 distinguished academic and industrial scientists.

Dr. James B. Conant, president of Harvard University, and Crawford H. Greenewalt, president of the Du Pont Company, were speakers at a banquet in the evening following an afternoon inspection by the visitors of the new laboratories, and presentation there of a series of exhibits designed to show the types of research work undertaken at the Station. Members of the company's board of directors, departmental officials, and heads of research staffs joined in the ceremonies and in the visit to the Station.

The expanded Station, near the site of the company's original plant beside historic Brandywine Creek, constitutes one of the largest research establishments in American industry, housing nearly half of Du Pont's total research personnel. The new area is on a 57-acre tract adjacent to the existing Station. Nineteen buildings were constructed in the expansion program, including nine laboratory buildings, one of which is located in the older area, and 10

service buildings. Two of the laboratory buildings in the older area were substantially enlarged as part of the project. The equipment and arrangement of the laboratory buildings embody many improvements.

The Station now has about 800 technically-trained research workers representing a wide range of sciences. In addition, it has approximately 1500 nontechnical employees.

Charles Thomas Elected President of Monsanto

Charles A. Thomas has been elected president of Monsanto Chemical Company, taking office on May 1st, 1951.

Dr. Thomas began his professional career in 1923 with the General Motors Research Corporation. In 1926, he and his associate, Dr. Carroll A. Hochwalt, organized the Thomas & Hochwalt Laboratories at Dayton, Ohio, which were acquired by Monsanto Chemical Company in 1936. Dr. Thomas became Central Research Director of the company, and later a company director. In 1945, he was elected vice-president and technical director of Monsanto and a member of the company's Executive Committee. He became chairman of this committee in 1949.

SECTION NEWS

New York Metropolitan Section

The New York Metropolitan Section held its regular meeting on March 28th at the Holley Hotel. After routine business was transacted, Chairman Copson appointed a Nominating Committee to submit a slate of officers for the coming year. Final plans for the Ladies' Night on May 2nd were discussed, and the treasurer's report given showing that the finances of the Section are in a healthy condition.

The feature of the meeting was the lecture by Dr. Keith H. Butler of Sylvania Electric Products Incorporated, Salem, Massachusetts, on the subject "Electrochemistry and Lighting."

Dr. Butler began his talk by showing how the fields of electrochemistry and lighting overlapped. In doing this, he stated that at several points it was necessary to expand the definition of electrochemistry in order to cover his topic. Continuing, he reviewed the development of the fluorescent lamp and pointed out some of the more recent innovations. Dr. Butler showed how the imperfections in the early lamps had been gradually overcome and pointed out the effects of various additives on such defects as bands, spots, aging, and other conditions.

In conclusion, the speaker described a new way of producing light which he called electroluminescence. This consisted of a phosphor of good dielectric properties placed between a glass having a conductive coating and the metal backing layer. High voltage, high frequency alternating current acting on this combination produces a very pleasing effect which at present is in the gadget stage but promises to have some definite applications. Dr. Butler's talk was well received and a lively question period followed.

F. A. Lowenheim, *Secretary*

Pittsburgh Section

A joint meeting of the Pittsburgh Section of The Electrochemical Society and the National Association of Corrosion Engineers was held on April 5th. The speakers of the evening were Dr. T. P. Hoar of Cambridge University and Dr. J. G. Jewell of the Gulf Research and Development Company. Dr. Hoar was in Pittsburgh during a five weeks' visit to the United States. A dinner was held in his honor prior to the meeting.

Dr. Hoar presented an extremely interesting account of recent researches at Cambridge University, especially in the fields of corrosion and electrochemistry, to which he has made highly important contributions. The work, in collaboration with Dr. U. R. Evans and Dr. J. N. Agar, includes studies of passivity and inhibition, cathodic protection, the shape of the potential fields that surround corroding specimens, and investigations of the fundamental mechanisms underlying corrosion phenomena.

Dr. Jewell then presented a complete review of the subject of chemical treatment to mitigate corrosion. The information on this was marshalled in such detail and with such thoroughness that it is believed its publication would provide a most useful guide to all interested in corrosion protection.

* * *

The Pittsburgh Section will hold an all-day meeting on June 8th at the Alcoma Country Club. The program will include morning and afternoon technical sessions and luncheon at the Club. Completed plans will be announced to the Section members, and an especially interesting meeting is anticipated.

M. Simnad, *Secretary-Treasurer*

PERSONALS

Roy E. Heath of Wyandotte Chemicals Corporation, Wyandotte, Michigan, has been named manager of a new department to be known as the Industrial, Railroad, and Aircraft Department, recently established by Wyandotte to accommodate their expanding sales volume.

Joseph Rossman, patent attorney, Washington, D. C., has opened an additional office in the Land Title Building, Philadelphia, Pennsylvania.

Clare L. Milton, Jr., has accepted a position with the Eastern Venetian Blind Company, Baltimore, Maryland.

Paul W. Leppla, Associate Director of Research at the Morton Grove, Illinois, research laboratory of Great Lakes Carbon Corporation, has been appointed Technical Director of the corporation's Dicalite Division, with headquarters in Los Angeles. Dr. Leppla's duties will include the development of new and improvd diatomaceous silica and related products, and the maintenance of high standards of technical service to the users of Dicalite materials.

MEETINGS OF OTHER ORGANIZATIONS

Edison Electric Institute, 19th annual convention, Denver, Colorado, June 4–7.

American Society of Mechanical Engineers, semiannual meeting, Royal York Hotel, Toronto, Canada, June 11–15.

American Society for Testing Materials, annual meeting, Chalfonte-Haddon Hall, Atlantic City, New Jersey, June 18–22.

American Institute of Electrical Engineers, summer general meeting, Royal York Hotel, Toronto, Canada, June 25–29.

Instrument Society of America, sixth national instrument conference and exhibit, Sam Houston Coliseum, Houston, Texas, September 10–14.

Firm Name Changed

The Standard Stoker Company, Incorporated, of York, Pennsylvania, has changed its corporate name to Read Standard Corporation. This is a change in name only; there has been no change in ownership, management, or personnel.

NEW MEMBERS

In April 1951 the following were elected to membership in The Electrochemical Society:

Active Members

DON M. ALSTADT, Lord Manufacturing Company, Erie, Pennsylvania (Electronics and Theoretical Electrochemistry)

LEE O. CASE, University of Michigan, 1245 Chemistry Building, Ann Arbor, Michigan (Battery, Corrosion, Electrodeposition, and Theoretical Electrochemistry)

PHILIP J. CLOUGH, National Research Corporation, 70 Memorial Drive, Cambridge, Massachusetts (Electrothermic)

WILLIAM O. DI PIETRO, National Research Corporation, mailing add: 32 Hillcrest Circle, Watertown, Massachusetts (Electrothermic)

FRANK H. EDELMAN, International Resistance Company, 401 N. Broad Street, Philadelphia 8, Pennsylvania (Electrodeposition)

HERBERT B. FORMAN, Metal & Thermit Corporation, mailing add: 922 Hoe Avenue, New York 59, New York (Theoretical Electrochemistry)

JOHN A. HARMON, Lawter Chemicals, Inc., mailing add: 3550 Touhy Avenue, Chicago 45, Illinois (Luminescence)

FRANK T. HERMAN, Kennecott Copper Corporation, mailing add: 66 Magna Row, Magna, Utah (Electrodeposition)

RAY M. HURD, Defense Research Laboratory, 500 East 24th Street, Austin, Texas (Theoretical Electrochemistry)

AKUNDI JOGARAO, Central Electrochemical Research Institute, Kottaiyur, Ramnad District, S. I. Rly, India (Electrodeposition and Electronics)

THOMAS O. JONES, Haverford College, Haverford, Pennsylvania (Theoretical Electrochemistry)

KENNETH J. KELLY, Pratt & Whitney Aircraft, mailing add: 17 Hughes Street, Hartford 6, Connecticut (Electrodeposition and Corrosion)

SHRI B. NARAYAN, Annamalai University, Annamalainagar, Chidambaram S.I. Rly, India (Industrial Electrolytic)

WILLIAM J. SCHLOTTER, Electric Storage Battery Company, mailing add: 608 Noble Street, Norristown, Pennsylvania (Battery and Theoretical Electrochemistry)

ELMER M. STROHLEIN, Electric Storage Battery Company, mailing add: 7222 Kindred Street, Philadelphia 24, Pennsylvania (Battery)

GARY STEVEN, Armour Research Foundation, 35 West 33rd Street, Chicago 16, Illinois (Electrodeposition and Electrothermic)

JOHN K. TAYLOR, National Bureau of Standards, mailing add: 6210 43rd Avenue, Hyattsville, Maryland (Theoretical Electrochemistry)

HAROLD A. WEVER, Hooker Electrochemical Company, mailing add: 213 Third Street, Niagara Falls, New York (Industrial Electrolytic)

Reinstatements

JULIUS GALE, Emerson Radio and Phonograph Corporation, mailing add: 400 Riverside Drive, New York 25, N. Y. (Battery and Electronics)

HILARY A. HUMBLE, Dow Chemical Company, Physical Research Laboratory, Midland, Michigan

NOTES FROM INDUSTRY

Publications

AMERICAN CHEMICAL PAINT COMPANY, Ambler, Pennsylvania, has issued a new folder on "Alodine," a superior product for the protection of painted and unpainted aluminum. "Alodine" forms an amorphous phosphate surface on aluminum which is thin, tough, durable, continuous with and a part of the basis metal. Photographs and charts included with the data. Copy sent on request.

SCIENTIFIC GLASS APPARATUS COMPANY INCORPORATED, Bloomfield, N. J., has just released a new 28-page edition of the publication "What's New for the Laboratory"—No. 12 in the series. New items illustrated are laboratory clamps of revolutionary design, a pail and dipper of special rubber-like material for handling corrosive chemicals, miniature pumps, a handled beaker, pocket-type thermometer, etc. Free copy on request.

Personalities

MANSON BENEDICT, recently appointed Professor of Chemical Engineering at Massachusetts Institute of Technology, will also serve as Scientific Director of the National Research

(*Continued on page 86C*)

SPRAGUE ELECTRIC COMPANY

Physicist and Physical Chemist

An attractive opening exists for a physicist with background and interest in solid state physics, to conduct research on oxides, ferrites, ceramics, etc.

Another position is available for a physical chemist or an electrochemist to conduct research on projects relating to oxide films.

These are permanent staff positions in the well-equipped, modern laboratories of the Sprague Electric Company, a major electrical component manufacturer, located in North Adams, Massachusetts.

Reply giving full details of educational background and experience to: Engineering Personnel, Sprague Electric Company, Marshall Street, North Adams, Massachusetts.

RECENT PATENTS

Selected for electrochemists by Fred. W. Dodson, Chairman of the Patent Committee, from the Official Gazette

February 6, 1951

Thomas, F. W., and Simon, E., 2,540,602, Method and Apparatus for the Surface Treatment of Metals

Lillienberg, A. W., 2,540,744, Induction Furnace

Anderson, J. T., and Wells, R. S., 2,540,804, Manganese Activated Zinc Barium Silicate Phosphor

Osborne, S. G., 2,540,960, Electrolytic Cell

February 13, 1951

Hoxeng, R. B., 2,541,062, Utilization of Aluminous Metal Electrodes in Cathodic Protection Installations

McDermott, E. B., 2,541,083, Electroplating on Aluminum

Odier, J. A., 2,541,275, Apparatus for the Electrolytic Oxidation of Metallic Elements

Rothschild, S., 2,541,384, Method of Making a Luminescent Zinc Sulfide

Vanselow, W., and Yutzy, H. C., 2,541,488, Electrolytic Diazo Process

(*Continued on page 86C*)

The New Constitution Needs Your Approval

At the annual meeting of the Society held in Washington, D. C., April 9, 1951, a new Constitution was presented. This Constitution is printed below and, according to Article X, "In its final form it is to be voted upon by a mail vote of the members of the Society, which is to be taken as soon after the annual meeting as practicable." The principal changes in this Constitution are: (*a*) In Article V, Section 6, the Secretary is to be appointed by the Board of Directors and shall serve under conditions set by, and at the pleasure of, the Board of Directors. (*b*) In Article VI, Sections 3 and 4, the dates of mailing ballots and date of counting ballots have been changed to allow the incoming officers sufficient time, prior to their assuming office, to prepare committee appointments, resulting in no loss of time at the beginning of an administration.

A special postcard, to be used in voting for these amendments, will be mailed to all active members the second week in June. Your cooperation is requested in getting this vote recorded in the headquarters office.

Constitution of The Electrochemical Society, Inc.

Article I

Name and Object

Section 1. The name of this organization shall be The Electrochemical Society, Inc.

Section 2. Its object shall be the advancement of the theory and practice of Electrochemistry, Electrometallurgy, Electrothermics, Electronics, and allied subjects. Among the means to this end shall be the holding of meetings for the reading and discussion of professional and scientific papers on these subjects, the publication of such papers, discussions, and communications as may seem expedient, and cooperation with chemical, electrical, and other scientific and technical societies.

Article II

Membership

Section 1. The membership shall consist of active members, student associate members, associate members, sustaining members, and honorary members.

Section 2. A candidate for active membership shall: be interested in the subject of electrochemistry or allied subjects; be at least 25 years of age; and possess a Bachelor's or Engineering degree with a major interest in the physical or natural sciences, and have three or more years of post-graduate experience in the phases of electrochemistry that are represented by the several Divisions of the Society. The post-graduate degree of Master of Science (or of Engineering) shall be equivalent to one year of experience, and the Doctor's degree in Science (or in Engineering) shall be equivalent to three years' experience. In lieu of a scholastic degree, ten years of experience shall be required in one or more phases of interest of the Society as represented by its several Divisions. One year of college work in physical science shall be deemed the equivalent of one year of experience. Election to active membership shall require, in addition, recommendation by two active members of three years or longer standing in the Society.

Section 3. A candidate for student associate membership shall be at least 18 years old and shall be a bona fide student in a Physical Science or Engineering course and shall be under 29 years of age. Election to student associate membership shall require recommendation by at least two active members of three years or longer standing in the Society. No student membership shall extend beyond the year in which the member becomes 28 years of age.

Section 4. A candidate for associate membership shall have received a Bachelor's or Engineering degree, with majors in Physical Science, but not yet have completed the requirements of three years' experience nor have exceeded the age of 28. Election to associate membership shall require recommendation by at least two active members of three years or longer standing in the Society. No associate membership shall extend beyond the year its holder becomes 28 years of age.

Section 5. Exceptions to satisfy the specifications in Sections 3 and 4 will arise when individuals have entered college or the electrochemical profession later than usual. The Board of Directors shall be empowered to waive the requirements of Sections 3 and 4 providing however, that they preserve the intent of these sections.

Section 6. The effective date of these qualifications for the various classes of membership shall be January 1, 1950. All members in good standing, elected prior to this effective date, shall automatically become "Active" members on January 1, 1950.

Section 7. Sustaining members shall be those who, through their interest in electrochemistry, contribute toward the support and development of the Society.

Section 8. Honorary members shall be those who, by reason of valuable contributions to electrochemistry, deserve special recognition by the Society.

Article III

Admission and Dismissal of Members

Section 1. Those who have, prior to April 6, 1902, notified the proper authorities that they wish to become members of the Society are by the adoption of this Constitution elected as charter members. They shall not be required to pay an entrance fee; they shall, however, be required to pay their dues for the current year within three months.

Section 2. Application for membership shall be in writing on a form adopted by the Board of Directors to conform with the qualifications for membership set forth in Article II.

Section 3. The Secretary shall submit to each Director the names and addresses of applicants and of their respective references, provided the applications are in due form and that the applicant has been favorably recommended by his references. The election to membership shall be by vote of the Board of Directors or of its Executive Committee. If a candidate receives one negative vote his application shall then be considered and voted upon at a duly called meeting of the Board of Directors. Two negative votes cast at this meeting shall exclude a candidate. The Board of Directors may refuse to elect a candidate who, in its opinion, is not qualified for membership. The names of those elected shall be announced to the Society. A candidate who has been duly elected shall be placed on the rolls and have all the rights and privileges of a member as soon as his entrance fee and dues for the current year have been paid.

Section 4. A member desiring to resign shall send a written communication to the Secretary, who shall report it to the Board of Directors who may accept and announce the resignation provided the dues and other indebtedness of that member have been paid up to the time of mailing of his resignation.

Section 5. Upon the written request of ten or more active members that, for cause stated therein, a member be dismissed, the Board of Directors shall consider the matter and, if there appears to be sufficient reason, shall advise the accused of the charges against him. He shall then have the right to present a written defense, and to appear in person before a meeting of the Board of Directors, of which meeting he shall receive notice at least twenty days in advance. Not less than two months after such meeting, the Board of Directors shall finally consider the case and, if in the opinion of the majority of the Board of Directors a satisfactory defense has not been made, and the accused member has not in the meantime tendered his resignation, he shall be dismissed from the Society.

Section 6. Sustaining members shall be admitted upon the approval of the Board of Directors.

Section 7. Honorary members shall be recommended over the signatures of at least ten members, and shall be elected only at the meeting of the Board of Directors in conjunction with a general meeting of the Society, and by the unanimous vote of the Directors, a quorum being present.

Honorary members shall pay no entrance fee or annual dues, and shall receive all the publications of the Society.

The number of honorary members shall not at any time exceed ten, and not more than two shall be elected in any one calendar year.

Article IV

Dues

Section 1. The entrance fee shall be payable on notification of election. If not paid within three months after notification, the election of the applicant is thereby canceled. Applicants for membership who are at the date of their election students in attendance at colleges, universities, and technical institutions shall be exempt from payment of the entrance fee.

Section 2. The annual dues shall be payable at the beginning of the calendar

year, and notice thereof shall be mailed to each member before the end of the preceding year. If not paid before the first day of April, the delinquent member shall lose his right to vote or to receive the publications of the Society, until said dues are paid. Members will pay dues for, and receive the publications of, the year in which they are elected, but if elected after July first will pay one-half the yearly dues and receive one-half of the publications of that year. Those members elected within two months of the end of the calendar year may, at their option, pay for, and enter with, the next coming year.

Section 3. Any member who, at the first day of April, is in arrears for one year shall be dropped from the rolls, and shall not be included in subsequently published lists of members. The Board of Directors may reinstate a member who has been dropped, provided all his arrears have been paid.

Section 4. Entrance fee, annual dues, and any other payments made by members to the Society shall be as prescribed in the By-Laws.

Article V

Officers

Section 1. Only active members are eligible to hold office in the Society. The officers of the Society shall be a President, three Vice-Presidents, a Secretary, and a Treasurer, who shall hold office as follows:

Section 2. The President, for one year. All other officers, for three years. Each year a President and one Vice-President shall be elected. At triennial periods beginning with the annual meeting of 1949 a Treasurer shall be elected. The terms of office of the several officers shall begin at 8:00 A.M. of the last day of the spring meeting or convention, prior to which they shall have been elected, and these officers shall hold office until successor has qualified.

Section 3. A vacancy in the office of President shall be filled by the senior Vice-President. All other vacancies shall be filled by the Board of Directors.

Section 4. No elective officer shall receive, directly or indirectly, any salary, compensation, or emolument from the Society, either as such officer or in any other capacity, or be interested directly or indirectly, in any contract relative to the operations conducted by the Society or in any contract for furnishing supplies thereto, unless authorized either by the By-Laws or by a vote of the majority of the entire Board of Directors.

Section 5. No revision or amendment of this Constitution shall affect the tenure of office of any duly elected and incumbent officer.

Section 6. After 8:00 A.M. of the last day of the spring meeting or convention of 1952, the Secretary shall be appointed by the Board of Directors and shall serve under conditions set by, and at the pleasure of, the Board of Directors.

Article VI

Election of Officers

Section 1. Prior to July 15th each year the Board of Directors shall appoint a Nominating Committee of five members, not more than two of whom may be officers or Directors of the Society, who shall send to the Secretary prior to the next ensuing August 15th its nominations for one or more candidates for each of the offices to be filled, except that for the Vice-Presidency at least two persons shall be nominated.

In selecting the candidates for the Presidency the members of the Nominating Committee shall be limited in their choice to persons who shall have been members of the Board of Directors at some period prior to their nominations and their choice shall be confined to members who have been active in the affairs of the Society.

It shall be the duty of the Nominating Committee to notify each candidate of his selection and any candidate desiring to do so may withdraw his name within one week of such notification.

Section 2. At the Directors' meeting held prior to November 15th in each year, the Board of Directors shall appoint three tellers, who shall not be members of the Board of Directors, and three alternates. Should the Directors' meeting not be held, the President shall appoint these tellers, who shall be notified by the Secretary.

Section 3. The Secretary shall mail to every active member, on or before September 15th, a ballot containing the names of all candidates thus nominated. An active member's vote for officers shall not be restricted to the Nominees whose names appear on the ballot. Only active members are eligible to vote, and voting shall be by secret letter ballot; the voter shall sign his name on an outside envelope, and the ballots shall be enclosed in an inner sealed and unmarked envelope.

Voting ballots must reach the Secretary before the fifteenth day of December.

Section 4. The tellers shall meet as soon after the fifteenth day of December as possible. The Secretary shall deliver to the tellers all ballots received, eliminating all ballot envelopes received from members not entitled to vote because of nonpayment of dues. The tellers shall proceed in secret to count the votes received before the fifteenth day of December.

All ballots shall be returned to the Secretary, who shall preserve them for one month. At the end of one month the Secretary shall return to the senders all rejected envelopes and shall open all unidentified envelopes. The eligible person receiving the greatest number of votes for an office shall be considered elected. The tellers shall prepare and sign a report of the results of the election, which shall be handed, sealed, to the Secretary, who shall forward it to the President, before the first day of January, who in turn shall notify the newly elected officers. The results of the election shall be published as soon as possible thereafter in the Society's Journal.

Section 5. At the request of the Board of Directors, these tellers shall count the ballots of any mail vote of the Society.

Section 6. The President and Vice-Presidents shall, after the expiration of the full term of office to which they were elected, be ineligible for immediate re-election to the same office. The Treasurer may be re-elected once to the same office but he cannot be elected to serve a third or subsequent term until a period of three years has elapsed.

Article VII

Management

Section 1. The affairs of the Society shall be managed by a Board of Directors under this Constitution and By-Laws. The Board of Directors shall be composed of the President, the immediate Past President, the three (3) Vice-Presidents, the Secretary, the Treasurer, the Chairman of the Publication Committee, the Chairman of the Membership Committee, the Chairman of the Local Section Advisory Committee, and the Chairmen of the several Divisions of the Society. The President, Vice-Presidents, Secretary, and Treasurer of the Society shall hold the same offices in this Board of Directors.

Section 2. The Board of Directors shall prepare and adopt a series of By-Laws which shall govern its meetings and its procedure, as also that of the Society, under this Constitution. It shall require a two-thirds vote of the whole Board to adopt or amend these By-Laws; proxy and mail votes shall be counted when received before the vote is counted. The text of the proposed By-Laws or amendments shall be furnished to each member of the Board of Directors at least ten days before the meeting at which the vote on the same is to be taken.

Section 3. The Board of Directors may delegate any or all of its powers, except in those cases in which this Constitution requires a vote of the whole Board, to an Executive Committee of not less than five members of the Board of Directors. The President, the Secretary, and the Treasurer shall be members of this Executive Committee. This Committee shall conduct the affairs of the Board of Directors between its meetings. All members of the Board of Directors shall receive notice of the meetings of this Executive Committee and shall have the right to attend and vote. A majority of the Executive Committee shall constitute a quorum.

Section 4. At the request of the President, matters requiring action by the Board of Directors may be discussed and voted upon by mail vote of the Board of Directors.

Section 5. The duties of the President, Vice-Presidents, and Treasurer shall be such as usually pertain to the offices they hold, besides any other designated in the Constitution or By-Laws or by the Board of Directors. The Secretary shall be in administrative charge to direct and supervise the duties usually pertaining to this office or designated in the Constitution or By-Laws or by the Board of Directors. The Secretary shall in all matters concerning the affairs of the Society carry out the prescriptions of the Constitution, By-Laws, rulings, and precedents, and in cases in which no such prescriptions exist he shall obtain decisions from the Board of Directors or Executive Committee, or if time does not permit he shall confer with the President. All funds expended in the Secretarial duties shall be under the control of the Secretary, who shall be responsible to the Board of Directors for the proper dispensing of such funds. The Secretary and the Treasurer shall present reports annually to the Board of Directors before the annual meeting. The Board of Directors, with the assistance of the Secretary, shall present a report annually to the Society at the annual meeting. The nature of these reports shall be specified in the By-Laws.

Section 6. All standing committees shall be directly responsible to the Board of Directors, and shall be appointed by the President subject to the approval of the Board of Directors.

Section 7. Any member of the Board of Directors, who finds that he is unable to attend a regularly called meeting of the Board, shall have the privilege of

appointing a proxy to act in his stead at such meeting. The person appointed to act as proxy shall be an active member in good standing in the Society, and if appointed by a Chairman of a Division or of a Committee shall preferably be a person conversant with the work of that Division or Committee. No member of the Board shall have the power to grant to any person a proxy for more than one meeting.

Article VIII

MEETINGS

Section 1. The annual business meeting shall be held between April 1st and July 1st, at such time and place as the Board of Directors shall designate. Business affecting the organization of the Society shall be transacted only at the annual meetings. Proxy or mail votes shall be received.

Section 2. Other meetings may be held at such times and places as the Board of Directors shall select. The President shall call a meeting at the written request of thirty or more active members.

Section 3. Notice of all ordinary meetings shall be sent to all members at least twenty days in advance, and of the annual meeting, thirty days in advance.

Section 4. Any ten active members at a meeting of the Society may require that any motion brought up be submitted to a referendum of the Society by a mail vote.

Article IX

GENERAL

Section 1. A quorum of the Society shall consist of fifty active members, present in person or by proxy.

Section 2. Only those active members whose dues have been paid for the current fiscal year shall be entitled to vote at any meetings. A member may vote by proxy or, when the subject matter has not been changed, by mail. No proxy shall be valid after the expiration of eleven months from the date of its execution. Every proxy shall be revocable at the pleasure of the person executing it.

Section 3. The fiscal year of the Society shall begin January 1st.

Article X

AMENDMENTS

Proposals to amend this Constitution shall be made in writing to the Board of Directors and signed by at least ten active members; they shall reach the Secretary not later than February 1st. The Board of Directors shall consider them and may amend them. The original, with the action of the Board of Directors, shall then be presented to the Society at its annual business meeting, at which time it may be further amended. In its final form it is to be voted upon by a mail vote of the members of the Society which is to be taken as soon after the annual business meeting as practicable. A majority of the votes cast shall decide.

Notes from Industry

(*Continued from page 83C*)

Corporation, Cambridge, Massachusetts. GORDON KIDDOO, former Director of Research and Development for Continental Carbon Company, Amarillo, Texas, has been appointed Assistant Director of the Petrochemical Research Department at the National Research Corporation.

ROY A. HUNT, President of Aluminum Company of America since 1928, was named Chairman of the Executive Committee and I. W. WILSON, Senior Vice-President, was made President of the company at a recent meeting of Alcoa's Board of Directors.

THOMAS P. COLLIER has been named manager of international research operations at Armour Research Foundation of Illinois Institute of Technology. Mr. Collier was formerly with Inter-American Orange-Crush Company.

EDWARD F. BEALE, formerly Controller of Pennsylvania Salt Manufacturing Company, was elected Secretary-Treasurer to succeed WARNER R. OVER, who has retired from active service.

BERTRAM M. STONE has been appointed Executive Vice-President of The Emil Greiner Company, 26 N. Moore Street, New York City. ROBERT E. BADER will succeed Mr. Stone as Treasurer of the company.

WILLIAM E. HARVEY of Speer Carbon Company, St. Marys, Pennsylvania, has been named Vice-President in Charge of Production of carbon and graphite products manufactured for Speer and its subsidiary, International Graphite and Electrode Corporation.

Recent Patents

(*Continued from page 83C*)

Egalon, R., Vanhille, R., and Willemyns, M., 2,541,578, Electrical Conductivity Cell for Measuring Flow

Midling, K. R., 2,541,597, Electroplating Rack

Scott, F., 2,541,617, Battery Terminal

Glassbrook, C. I., 2,541,697, Electronic Reactor

Holt, D. A., 2,541,700, Electroplating Copper

Roehl, E. J., and Wesley, A., 2,541,721, Process for Replenishing Nickel Plating Electrolyte

Herres, S. A., and Davis, J. A., 2,541,764, Electric Apparatus for Melting Refractory Metals

Quinn, F. R., 2,541,832, Electric Current Rectifier

Tama, M., 2,541,841, Unidirectional Flow in Plurality Chamber Induction Furnace

McEachron, E. D., McEachron, E. J., Schroeder, G. H., and Friang, H. G., 2,541,931, Leakproof Dry Cell

Potter, J. A., 2,541,935, Battery Charging Apparatus

Bonnet, M., 2,541,954, Process for Preparing Metallic Surfaces for the Engraving Thereof

February 20, 1951

Kun, E., Application 16,373, Cathodic Electrical Grounding

Klemperer, H., 2,542,035, Ionizing Device for Electrical Precipitators

McIntyre, G. H., and Ammon, M. G., 2,542,043, Method of Producing a Corrosion Resistant Coating on Steel

Penney, G. W., and Hewitt, G. W., 2,542,054, Electric Apparatus for Cleaning Oil

Ravenscroft, A. W., 2,542,056, Electrode Support for Electrolytic Cells

Relis, M. J., 2,542,057, Method and Apparatus for Measuring the Conductivity of an Electrolyte

Nagy, R., 2,542,091, Zinc Silicate Phosphors and Method of Making Same

Richardson, R. P., and Lewis, R. W., 2,542,094, Primary Electric Cell

Borngesser, O. R., 2,542,112, Method of Regenerating Aluminum Anodizing Solution

Ellefson, B. S., 2,542,122, Luminescent Materials and Method of Manufacture

Briney, R. M., 2,542,177, Manufacture of Chromium Steels

Froelich, H. C., 2,542,322, Method of Preparing Calcium Silicate Phosphor

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